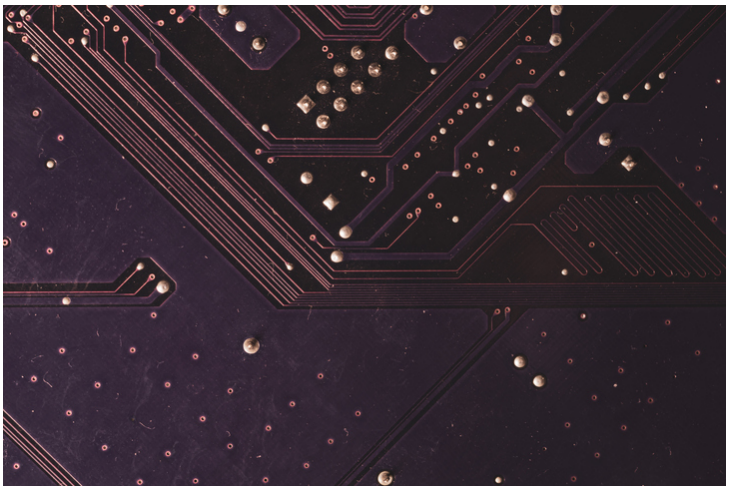
INNOVATION PARTNERSHIPS
UNIVERSITY OF MICHIGAN

Ultra Low-Cost Defect Protection for Microprocessor Pipelines

Technology Number: 3525



Technology ID

3525

Category

Hardware
Engineering & Physical Sciences
Semiconductor, MEMS, and Electronics

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OVERVIEW

Cost-effective, reliable chip fault detection and repair in nanometer transistor devices

- Provides fine-grained protection with only 5.8% overhead versus traditional 100% duplication
- Online microprocessor testing, microprocessor pipeline protection, on-chip cache memory safeguarding

BACKGROUND

As silicon transistor technologies advance into the nanometer regime, the reliability of these devices becomes increasingly critical. Device scaling exacerbates long-standing silicon failure mechanisms like electromigration and hot carrier injection, and introduces new, complex failure modes. These reliability issues pose significant risks to component yield and lifespan, which are paramount for the functional and economic viability of semiconductor devices. Traditional reliability strategies, such as resource duplication, struggle with high overhead, often requiring a 100% increase in resources. This method not only boosts costs but also consumes crucial space on the chip, making it less feasible for large-scale application. Therefore, there is an urgent need for innovative solutions that ensure reliable operation without excessive resource demands or performance penalties.

INNOVATION

Researchers at the University of Michigan have developed a low-cost, reliable system design approach for detecting, diagnosing, recovering, and repairing silicon defects occurring during field operation. This novel approach relies on online testing, achieving nearly the same protection level as traditional methods but with a mere 5.8% overhead, as opposed to the 100% typically required by duplication of critical resources. When defects are detected, the system operates in a degraded mode with only moderate performance impacts, ranging from a 4% to 18% slowdown. The approach protects 89% of the prototype design's total area against silicon defects, demonstrating high efficacy. Potential applications for this technology include online testing and protection of microprocessor pipelines and on-chip cache memories, ensuring reliable performance in advanced semiconductor devices at a fraction of the cost and complexity of traditional methods.

ADDITIONAL INFORMATION

US7966538 “Microprocessor and method for detecting faults therein”